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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/927,265	08/10/2001	Thomas M. Barbara	01-04 US	5283

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EXAMINER

VARGAS, DIXOMARA

ART UNIT

PAPER NUMBER

2859

DATE MAILED: 12/10/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/927,265	Applicant(s) BARBARA, THOMAS M.	
	Examiner Dixomara Vargas	Art Unit 2859	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 November 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3,5 and 7-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3,5,7,8,11,12,14,15,19 and 20 is/are rejected.
- 7) ☒ Claim(s) 9,10,13 and 16-18 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 3, 7, 8, 11, 12, 14, 15 and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mansfield et al. (US 4,978,920) in view of Hass et al. (US 5,729,141).

With respect to claim 1, Mansfield discloses an extended Maxwell pair comprising (Figures 19 and 25; Column 17, lines 25-26): a pair of semi-cylindrical gradient coils disposed coaxially around and along a z-axis extending in z-direction and symmetrically with respect to an origin (Figures 19 and 25), each being of radius a and of axial length d (Column 12, lines 18-32; Figures 19 and 25), said pair being mutually separated by a center-to-center distance Z_0 which is greater than d (Figures 19 and 25); and means for causing equal magnitude currents to flow through said gradient coils in mutually opposite directions (Figures 19 and 25; as shown by arrows); values of d and Z_0 being selected such that said equal currents generate a magnetic field along said z-axis with a linear gradient near said origin in said z-direction (Column 12, lines 27-29); a pair of shield coils disposed coaxially around said gradient coils, each of said shield coils being of radius b which is greater than a (Column 17, lines 30-34; Figure 25, #S1 and #S2), said means causing said equal magnitude currents and opposite sense and selected non-uniform axial

current density dependence to flow through said shield coils (Column 16, lines 43-68), said shield coils serving to cancel magnetic field outside said shield coils (Column 12, lines 29-32).

Mansfield discloses the claimed invention except for the shield coil pair being of equal radius and axially spaced. However, Hass discloses the shield coils of equal radius and axially spaced (Figure 17, wherein the gradient is #64 and the shield is #62). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use Hass teachings for the shielding configuration with Mansfield's Maxwell pair for the purpose of increasing the space within the bore so as to attain open regions with a reduction of the interaction of the RF field with the gradient and reduce eddy currents produced in the conductors as shown by Hass (Column 2, lines 44-64).

3. With respect to claim 3, Mansfield discloses said magnetic field along said z-axis, when expanded in a polynomial form in z, does not include a cubic term (Column 12, lines 35-50).

4. With respect to claim 7, Mansfield discloses each of said shield coils comprises a wire which is wound cylindrically at specified intervals, said intervals being determined such that said shield coils have effects of canceling magnetic field external to said shield coils (Column 12, lines 29-32; Figure 25).

5. With respect to claims 8 and 19, Mansfield discloses a and d are of a same order of magnitude (Figures 19 and 25).

6. With respect to claim 11, see rejection of claims 1 and 9 above.

7. With respect to claim 12, Mansfield discloses said shield coil current distribution by discrete conductor disposition on said cylindrical shield coil surfaces (Columns 17-18, lines 25-66 and 1-47 respectively; Figure 25).

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8. With respect to claims 14 and 15, Mansfield discloses said linearity equation is solved numerically (Column 17, lines 30-45).
9. With respect to claim 20, see rejection of claims 1, 9 and 10 above.
10. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mansfield et al. (US 4,978,920) in view in view of Hass et al. (US 5,729,141) and in further view of Vavrek et al. (US 5,185,576).

With respect to claim 5, Mansfield and Hass disclose the claimed invention as stated above in paragraph 2 except for said gradient coils comprises a helically rolled rectangular conductor sheet. However, Vavrek discloses said helically rolled structure (Figures 2 and 3). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use Vavrek's teachings for the gradient coil configuration with Mansfield and Hass' Maxwell pair for the purpose of avoiding interaction between the gradient with any other RF coil and improving the SNR (Column 4, lines 3-17).

Allowable Subject Matter

11. Claims 9, 10, 13, 16-18 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.
12. The following is a statement of reasons for the indication of allowable subject matter:

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With respect to claims 9 and 13, the prior art fails to teach or fairly suggest a Maxwell gradient pair with axially spaced shielding of opposing current coils wherein a , b , d and Z_0 satisfy an equation given by $\int^{k_{\max}} dk k^4 \{ \sin(kd/2) \sin(kZ_0/2) / (kd/2) \} S_0(k) K_0'(ka) I_0(k\rho) = 0$ where $S_0(k) = 1 - K_1(kb) I_1(ka) / K_1(ka) I_1(kb)$, and K_1 are modified Bessel functions, k_{\max} is an appropriately selected upper limit of integration and ρ is an appropriately selected value less than a .

13. With respect to claims 10 and 17, the prior art fails to teach or fairly suggest a Maxwell gradient pair with axially spaced shielding of opposing current coils wherein the gradient coils and the shield coils are structured such that the equal currents will have current distribution along said z -axis given by j and j respectively for said gradient coils and said shield coils, and a shielding equation given by $I^S(k) = -(a/b)(I_1(ka)/I_1(kb))I^P(k)$ is satisfied where I_1 are modified Bessel functions of the first kind, $I^P(k)$ and $I^S(k)$ are current density functions $I^P(z)$ and $I^S(z)$ respectively for said gradient coils and said shield coils Fourier-transformed into k -space, $I^P(z) = \int_{-\infty}^z dz' j^P(\varphi, z')$ and $I^S(z) = \int_{-\infty}^z dz' j^S(\varphi, z')$.

14. With respect to claims 16 and 18, the claim has been found allowable due to its dependency on claims 13 and 17 above.

Response to Arguments

15. Applicant's arguments filed on November 3, 2003 have been fully considered but they are not persuasive.

16. Applicant argues the following:

The matter of the structural form mentioned (coil) does not cure the problem that nowhere in this prior art is there any discussion of a “shield” other than an RF shield. Even if the Examiner prefers to consider Hass’ fleeting reference to a “coil” structure as significant, it is clear that there is no basis for assuming that the very different axial spaced geometry of Hass’ (RF) shields is incorporable in Mansfield’s arrangement that requires radially spaced coils. Again, there is no prescription in Hass for providing an axial current distribution in any such coil/shield to support cancellation of a gradient magnetic field along the z axis.

17. The examiner disagrees with applicant arguments because Mansfield discloses the gradient to be shielded with shielding means of equal and opposite currents. However, it fails to have the structure wherein shielding coils are spaced apart similarly to the gradient coil configuration been shielded as discuss in paragraph 2 above. However, the secondary reference of Hass shows the possibility of having a shielding configuration wherein the shielding coils are spaced apart similarly to the coil configuration been shielded regardless of the coil type been shielded. Applicant is advised that the secondary reference does not need to show the remaining limitations of the claim in order to be combined with the primary reference. In addition, Figure 17 in Hass’ reference shows the gradient coil structures (#64) been surrounded by the shielding cylinders (#62) and excitation coils (#70A-#70D) been surrounded by a second shielding layer (#66). It can be concluded that both shielding types are disclosed, RF shielding and gradient shielding as opposed to an RF shield only. Therefore, one of ordinary skill in the art would have been motivated to look for an alternative suitable configuration to shield the gradient coil assembly and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

Conclusion

18. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The additional prior art cited in the PTO 892 discloses gradient coil pair configurations with shielding coils surrounding the gradient coils.

19. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dixomara Vargas whose telephone number is (703) 305-5705. The examiner can normally be reached on 8:00 am. to 4:30 pm..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego Gutierrez can be reached on (703) 308-3875. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

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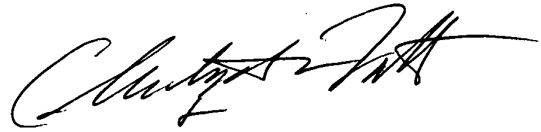
Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.



Dixomara Vargas

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December 6, 2003



Diego Gutierrez

Supervisory Patent Examiner

Technology Center 2800

**CHRISTOPHER W. FULTON
PRIMARY EXAMINER**